SUBJECT INDEX

Absorption spectra 235, 263
Activation energy
  dependence in martensitic transformation 27–29
  variation in martensitic transformation 19–22
Adiabatic potential energy surfaces
    (APES) 209–210, 231, 237
Ag^+ 214
AISI 3810 steel powder, mechanical properties 63–64
Al–Ge–Nb powder mixtures 126
Al–Si alloy powder 54–60
Alkali halides
  aggregation and precipitation of cation impurities
    in 187–286
  clustering in 191
Alkaline earth impurities 246–259
Amorphization of intermetallic compounds 127
Atomic mixing in diffusion couples 117–119
Atomic mobility 109
Atomic site disorder 119
Au^+ 214
Au–La alloys 108
Au–La diagram 101, 102
Au–La films 95
Au–La free energy diagram 100–102
Au–La multilayers 97
Au–La system 96, 100
Au–Zr diffusion couples 113
Auger depth profiling 97
Autocatalytic parameter 25
AuZn 125
Axial next-nearest neighbor (ANNNI) model 172

Ball-milling process 125
β phase
  changes of order 146–149
  high temperature 164–170
β phase alloys 150
Bismuth high pressure phase diagram 128
Bohr magneton 223
Bragg–Williams alloy theory 122, 123
Bragg–Williams–Gorski (BWG) model 165–169
Bravais lattices 137, 138, 139
Brillouin zones 139, 172, 182, 183
Broad band spectra 209–210
Bulk metallic glass 114–116

Ca^{2+} 246
Cation impurities in alkali halides 187–286
C-curve behavior 17
C-curve kinetics 14
Cd^{2+} 214
Clapeyron equation 83, 127
Clausius–Clapeyron equation 153, 155, 157
Close packed equilibrium phases 170–172
Cluster variation (CV) method 165
Clustering process 188, 220, 231–243
  hardening effect associated with 271–272
Co^{2+} 213
CoAl 125
Co–Y alloys 126
Co–Zr diffusion couples 107, 113
Co–Zr multilayers 97
Co–Zr powder mixtures 126
Cohesion energy 139
Configurational coordinate (CC) model 209
Configurational potential 139
Copper powder, effect of melting 68
Cotterill dislocation theory 129
Crystal field schemes 207–209
Crystal to glass transformation 81–134
  composition-induced destabilizaton 94–116
  kinetics and thermodynamics 83–94
Crystalline alloys, vitrification of 94–116
Cu^+ 214
Cu–Al–Ni system, stress-induced phases in 163–164
Cu–Er composites 114, 126
Cu–Ti powder mixtures 126
CuTi 125
Cu–Zn alloys 135–186
  phase diagram 140
Cu–Zn–Al alloys 135–186
  phase diagram 145
Cu–Zr powder mixtures 126

d^{10} ions 214–215
Debye criterion 93, 101, 119
Debye model 130, 173
Debye solids 154
Debye temperature 92, 93, 112, 154, 155, 157, 173
Debye wavenumber 93
Defect-induced catastrophe 129
Defects 119
Dielectric relaxation 190–192
Differential scanning calorimetry 116
Diffusion couples 95–109, 130
  atomic mixing in 117–119
  driven by irradiation 119
Dihalide precipitates 273
Dipole aggregation 201
Dipole clusters, hardening by 271–272
Dipole configurations 229
Distended materials, shock response of 47–52

Divalent cations 227–261
Driven composition profiles 117–119
Dynamic consolidation of metal powders
  complete melting 52–53
  computer simulations 73–74
  effect on mechanical properties 63–64
  interparticle melting 54–58
  localized effects 52–53
  localized solid state transformations 60–63
  metallurgical effects 52–64
  methodology of 75–77
  models of localized energy deposition 64–70
  shock pulse duration–energy map 70
  technological assessment 72–73

Egami criterion 92, 101, 102, 119
Electrical conductivity 196
Electron lattice coupling 209–211
Electron microscopy 194–196
Electron paramagnetic resonance (EPR) 222, 223–235, 248, 265, 266
Electron paramagnetic spectroscopy 190
Electron–phonon coupling 211
Electron spin resonance (ESR) 222
Emission spectra 235, 241, 242, 251
Enthalpy difference
  between β phase and 9R in Cu–Zn alloys 176–178
  between β phase and 9R in Cu–Zn–Al alloys 178–180
Enthalpy of formation 170, 176
Entropy of transformation 172–174
Equilibrium approach 87–89
Equilibrium phases 164–184
Eu^{2+} 215–216, 232, 241, 242, 245, 247, 248, 259, 266, 267
Excitation transfer spectroscopy 217–218
Externally driven systems 116–128

Fe–Ni alloys 22, 33
Fe–Ni–Mn alloys 11, 27, 32, 34
Fe–Zr powder mixtures 126
Fermi sphere 183
Fermi surface 139, 172, 182, 183
Fick's diffusion law 104, 118
Filamentary composites 114–116
Flotation technique 197
Fourier heat flow equation 117
Free dipoles, hardening by 265–271
Free energy curvature 92
Free energy diagram 96, 116

γ phase precipitates 149–150
Ge–Nb powder mixtures 126
Gibbs criterion 89–94
Gibbs free energy 83, 129, 138, 152
Gibbs phase rule 83, 87
Gibbs stability criterion 94
Gibbs surface 151
Gorecki vacancy theory 129
Grain size effect on martensite kinetics 25–27
Ground state order enthalpy 170

Hardening
  by dipole clusters 271–272
  by free dipoles 265–271
  by precipitates 272–278
Heat of formation 171, 180
Heterogeneous nucleation 112–114
Hg^{2+} 214
Huang–Rhys factor 210
Hydrogen in metallic alloys 109–112

Impurities 188, 220, 221
Impurity hardening 264–278
Impurity–vacancy (I–V) complexes 189
Impurity–vacancy (I–V) dipoles 198, 201, 205, 227, 228, 231, 236, 268
Instability 100–102
Interconfigurational transitions 211
Interface-limited growth 105
Intermetallic compounds, amorphization of 127
Internal friction 197
Intraconfigurational transitions 211
Ion mixing 117
Ionic thermocurrents (ITC) 190, 192, 228, 236, 265, 271
Ionizing radiation 278–281
IrAl 125
Irradiation of metals and intermetallic compounds 119
Isolated dipoles 227–231
Isothermal transformation curves 14–17

Jahn–Teller distortion 231
Jahn–Teller effect 212
Jump conditions 41

Kaufman–Cohen model 27–29
KBr 261
KCl 259–261, 263
KI 261
Kinetic constraints 87–89, 109
Kramers theorem 224

Lamellar composites 114–116
Lattice stabilities 184
LiCl 246
LiF 244–246
Ligand field schemes 207–209
Light scattering 197
Lindemann theory of melting 129–130
Long period structures (LPS) 183
Long period superlattices (LPS) 171–172
Long range order 164–165, 178, 181–183
Luminescence measurement 206–212
Luminescence spectra 235

Magnetic fields, effect on martensitic transformation 33–34

Martensite
aging and stabilization in 150
stability 172–184
surface 150–151
Martensitic nucleation 22
Martensitic phases and their structures 140–145
Martensitic transformation 136–144
activation energy dependence on driving force 27–29
activation energy variation 19–22
and its composition dependence 144–146
between 9R or 18R and face centered tetragonal 3R (6R) phase 158–161
between 9R or 18R and hexagonal 2H phases 162–163
between β phase and 3R or 6R martensite 161–162
between β phase and 9R or 18R martensite 156–157
between close packed phases 180–184
comparison of proposed models 17–18
composition dependence of 145–146
experiments on isothermal kinetics 4–10
from high temperature B2 or L2, phase to 9R or 18R structure 172–180
grain size effect 25–27
influence of tetragonal distortion 174–176
isothermal 1–37
magnetic field effect 33–34
number of nucleation sites 18–19
qualitative kinetic classification 3–4
quantitative models for isothermal kinetics 10–22
shortcomings of proposed models 18
stress-induced 151–164
sweeping-out effect 18
thermodynamic considerations 151–155
Maxwell relations 153
Mechanical alloying 125–127
Mechanically driven systems 125–127
Metal interdiffusion constant 104
Metal powders
dynamic consolidation of 39–80
complete melting 52–53
computer simulations 73–74
effect on mechanical properties 63–64
interparticle melting 54–58
localized effects 52–53
localized solid state transformations 60–63
metallurgical effects 52–64
methodology of 75–77
models of localized energy deposition 64–70
shock pulse duration–energy map 70
technological assessment 72–73
Metastability limit 90
Metastable crystals 129
Metastable phases 83–87
Mn^{2+} 213, 245, 246, 253, 258
Mo–Re alloys 108
Mo–Ru alloys 108
Monoclinical distortion 143, 146
Monovalent cations 262–264
M_s temperature 146–150

NaBr 261
NaCl 246–259
NaI 261
Narrow band spectra 211
Ni^{2+} 214
Ni–Hf bilayers 99
Ni–Hf diffusion couples 109
Ni–Hf glasses 107
Ni–Nb alloys 126
Ni–Ti powder mixtures 126
Ni–Zr
composite 116
diffusion couple 98
films 105
glasses 107
glassy layers 106
interlayer 112
multilayer films 115
multilayers 97
powder mixtures 126
system 100, 101
NiAl 125
Noble metal alloys 184
phase stabilities in 136–144
ns^2 ions 212–213, 249
Nuclear magnetic resonance (NMR) 190, 222
Nuclear quadrupole resonance (NQR) 222

Optical absorption 206–212, 262, 273, 274, 276
Optical microscopy 194–196
Optical paramagnetic spectroscopy 190
Optical spectroscopy 205–221
Order–disorder kinetics 123
Order–disorder transformation 139, 144, 164–172
Orowan mechanism 274
Ostwald ripening model 274

Pair interchange energy ratio 166
Paramagnetic resonance spectroscopy 221–227
Pb^{2+} 248, 252
Peierls mechanism 267
Phase diagrams 85–87
Phase stabilities 184
in noble metal alloys 136–144
Plastic flow behavior of TRIP steels 31
Point defects 188, 221
Polymorphous phase diagrams 100–102
Porous equation of state 48–49
Porous materials, shock response of 47–52
Portevin–Le Chatelier (PLC) effect 271
Powder Hugoniots measurements 49–52
Powder metallurgy 114–116
Powder mixtures 125–127
Precipitate structures 202
Precipitated phases 243–261
Precipitates 220–221
hardening by 272–278
Precipitation process 188
Pressure-induced vitrification 127–128

Radiation scattering techniques 197
Raman effect 218
Raman spectroscopy 218–21, 243

Rare-earth ions 215–216, 226–227, 258–259
Rayleigh scattering 197
RbBr 261
RbCl 261
Reordering kinetics 124
Rigid lattice transitions 206–207
Russell–Saunders approximation 224
Rutherford backscattering spectroscopy (RBS) 99, 105, 106
RuTi 125
Rutile (TiO_2), recovery fixtures for shock-loaded specimens 73

Scanning electron microscopy (SEM) 194–196
Scattering factor 183
Shock response of porous materials 47–52
Shock wave concepts 40–47
Short range order (SRO) 164, 168, 169, 171, 178
Small angle X-ray scattering 197
Sn–Nb powder mixtures 126
Spin–Hamiltonian 223–226
Spin–Hamiltonian parameters 245, 246, 249
Spinodal instability 90
Splitting factor 223
Stacking fault energies 181
Stacking sequence 142
Stored energy 198
Strain ageing 270
Superlattice reflections 183
Suzuki phase 202, 243, 253, 258, 277

Tetragonal distortion 143, 174–176
Thermal annihilation kinetics 252
Time dependent perturbed angular correlations (TDPAC) 190
Tl^+-like ions 262, 263
Transformation hysteresis 149
Transition metal ions 213–214
Transition metals 226–227
Transmission electron microscopy (TEM) 57, 97, 194–196
TRIP steels, plastic flow behavior of 31

Unstable phases 89–94

Vanadium-modified steel powder 60–62, 68–69
Van der Waals equation of state 90
Vibrating lattice 209
Vibrational enthalpy 172–174
Vibronic structures 211
Virtual crystal approximation 139
Vitrification of crystalline alloys 94–116

Walser and Ben rule 103

X-ray diffraction analysis 114, 193–194
X-ray diffraction patterns 95, 109, 115

Yield-stress 188, 268, 269, 271–274, 276, 277
Young's modulus 153

Zeeman splitting 223–225
Zn^{2+} 214
ZrNi intermetallic compound 98, 114
ZrRh intermetallic compounds 110–112